

Remarks

Claims 1-15 and 17-27 are pending. Claim 1 has been amended to provide for a carrier system being present that allows for the modulation of a multitude of the corresponding [4n]-annulene molecules for the permanent or erasable storage of their corresponding conjugative states. Support for this feature is provided in the last paragraph of page 16. No new matter has been added.

The present invention is directed to a process or a method for information storage and data processing using substituted [4n]annulenes, not the [4n]annulenes per se (except the novel [4n]annulenes of claim 16) nor double bond shifts of [4n]annulenes. Applicants submit that the amendment described above now clearly provides that at least two distinct and stable conjugation states are present.

The Examiner rejects claims 1 and 18 under 35 U.S.C. 112(2) as being indefinite. The Examiner objects to the phrase "like azobenzene". The phrase has been deleted.

The Examiner objects to the phrase "which provides the possibility to use distinct conjugation states" as being inconsistent with the preamble in claim 1. The Examiner believes that a method for information storage and data processing must at some point have distinct conjugation states. Applicants have amended claim 1 to require stable, discernible and distinct conjugation states.

The Examiner objects to claim 27 as directed to unsupported polymers. Claim 27 now properly depends from claim 26.

The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Triplet-State Cis-Trans Isomerizations of a Bissstyrylcyclooctatetraene", by Ingjald Anger et al., J. Phys. Chem. 99, 650-652 (D1). Applicants respectfully traverse this rejection.

Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. Claim 25 requires a double bond shift for the generation of two different conjugation steps. A cis-trans isomerization is not a double bond shift. D1 does not anticipate claims 1, 2, 6, 7, 11-14 and 25.

The Examiner rejects claims 1-7, 12, 13 and 25 under 35 U.S.C. 102 as being anticipated by an abstract entitled "Synthesis of New Photo- and Thermochromic Systems Based on Cyclic Double Bond Shifts in Heptalenes" El Houar et al., *Chimia* vol. 50, pp. 341 (7/8-1996) (D2). The Examiner refers to formulae 3 and 4. Applicants respectfully traverse this rejection.

The Examiner replied to Applicants prior remarks that the claims embrace both photo- and thermal-excitation between states. The concluding line indicates that, upon standing, the compound slowly rebuilds. Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. With respect to claim 25, the reaction sequence of note does not disclose the use of such compounds in selected regions of a storage medium. Hence, D2 does not anticipate claims 1-7, 12, 13, and 25.

The Examiner rejects claims 1-7, 12, 13 and 17-26 under 35 U.S.C. 102 as being anticipated by an article entitled "Synthesis and Dynamic Behavior of Chiral Heptalenes", by Klaus Hafner et al, *Bull. Chem. Soc. Jpn.*, vol. 61, pp. 155-163 (1988) (D4). Applicants respectfully traverse this rejection.

The Examiner maintains that the claims embrace isomerization, which is shown in D4. Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. Claim 25 requires the processing of at least two different conjugation states in selected regions of a storage medium. D4 does not anticipate claims 1-7, 12, 13, and 17-26.

The Examiner rejects claims 1-7, 12, 13 and 17-26 under 35 U.S.C. 102 as being anticipated by an article entitled "Formation of Cyclic ortho-Anhydrides of Heptalene-1,2-dicarboxylic Acids", by Weber et al., *Helvetica Chimica Acta*, vol. 70, pp. 1439-1460 (1987) (D5). Applicants respectfully traverse this rejection.

The Examiner maintains that the claims embrace isomerization, which is shown in D5. Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. Claim 25 requires the processing of at least two different conjugation

states in selected regions of a storage medium. Claim 26 requires that at least one of said substituents C¹ and C² contain an extended conjugated π -electron system, which is in conjugation with the π -electron system of the heptalene core. Extended conjugated π -electron system means that at least two conjugated double bonds have to be present. Compounds 9 and 11 on page 1441 do not fulfill said requirement. D5 does not anticipate claims 1-7, 12, 13, and 17-26.

The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Ring Inversion and Bond Shifting Energetics in Substituted Chiral Cyclooctatetraenes", by Paquette, L.A., Pure Applied Chem., vol. 54(5), pp. 987-1004 (D6). Applicants respectfully traverse this rejection.

The Examiner maintains that the claims embrace isomerization, which is shown in D6. Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. Claim 25 requires the processing of at least two different conjugation states in selected regions of a storage medium. D6 does not anticipate claims 1, 2, 6, 7, 11-14 and 25.

The Examiner rejects claims 1, 2, 6, 7, 11-14 and 25 under 35 U.S.C. 102 as being anticipated by an article entitled "Novel pericyclic reactions in p-perimeter chemistry", by Hafner et al., Pure Applied Chem., vol. 65(1), pp. 17-25 (1993) (D7). Applicants respectfully traverse this rejection.

The Examiner maintains that the claims embrace isomerization, which is shown in D7. The Examiner also relies upon compound 27. Claim 1 has been amended to require a carrier for the permanent or erasable storage of distinct and discernible conjugation states. Claim 25 requires the processing of at least two different conjugation states in selected regions of a storage medium. D7 does not anticipate claims 1, 2, 6, 7, 11-14 and 25.

The Examiner rejects claims 1-9, 11-14 and 25 under 35 U.S.C. 103 as being unpatentable over D2 in view of U.S. Pat. No. 5,438,561 (D9). D9 is cited as showing the use of photochromic compounds in polymeric binders. The Examiner alleges that it would be obvious to use the

photochromic compounds shown in D2 in polymeric binders. Applicants respectfully traverse this rejection.

The fact that different physical properties arise from a double bond shift (UV/Vis absorption), as contemplated in D2, does not provide any information on the possibility to use such compounds for data processing. D9 relates to a method for recording and reproducing information using an optical memory device being constituted by a transparent substrate, a recording film formed on the substrate and made of a resin containing a photochromic material dispersed therein. Specific examples of the photochromic material are diarylethene derivatives and nitrospirothiopyran. D9 (as well as D2) does not contain any hint that substituted [4n]annulenes can be used in a method for information storage and data processing. There is no motivation to combine the references as urged by the Examiner. The teachings of D2 and D9 fail to render the claimed invention unpatentable.

The Examiner rejects claims 1-9, 12 and 16-25 under 35 U.S.C. 103 as being unpatentable over D2 in view of U.S. Pat. No. 5,432,873 ("D10"). D10 is cited as showing the use of photochromic compounds in optical switches. The Examiner alleges that it would be obvious to use the photochromic compounds shown in D2 or D3 in optical switches. Applicants respectfully traverse this rejection.

D10 relates to an optical switch in which a compound including a photochromic material is placed between two optical waveguides. According to D10 examples of photochromic materials are derivatives of fulgide, anthracene, azobenzene, hydrazine, oxazone, diarylethene, salicylaldehyde, spiropyran, biimidazolyl and cyclophan (see D10, column 6, line 18 to 21). According to D10, column 5, line 61 to column 6, line 21 the photochromic material must meet specific conditions to be suitable for the optical switch according to D10. That is, not any photochromic material is suitable for information storage and data processing. Consequently, D10 does not teach or suggest the use of substituted [4n]annulenes in a method for information storage and data processing. The teachings of D2 and D9 fail to render the claimed invention unpatentable.

The Examiner rejects claims 1-7, 10, 12 and 16-25 under 35 U.S.C. 103 as being unpatentable over D2 in view of an extract from "The Applications of Holography", by H.J. Caufield et al. (D11).

D11 is cited as showing that photochromic holography medium is conventional or well known. The Examiner alleges that it would be obvious to use the photochromic compounds shown in D2 in holographic media. Applicants respectfully traverse this rejection.

D11 contains a general disclosure that various recording media, including photochromic materials, have been used for holographic recording. No specific photochromic materials are mentioned in D11, however. Therefore, D11 does not teach the use of substituted [4n]annulenes in a method for information storage and data processing. The teachings of D2 and D9 fail to render the claimed invention unpatentable.

Applicants submit that the instant application is now in condition for allowance. In the event that minor amendments will further prosecution, Applicants request that the Examiner contact the undersigned representative.

Respectfully submitted,



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Amended Claims with underlining and bracketing

1. (3X amended) Method for information storage and data processing comprising the step of thermo-inducing or photo-inducing double-bond shifts in substituted [4n]-annulenes which are substituted by at least one group comprising an extended conjugated π -electron system which is in conjugation with the π -electron system of the [4n]-annulene core, thus generating transitions between two different conjugation states with at least one substituent, resulting in different UV/VIS spectra of the double-bond shifted isomers of [4n]-annulene, which provides the possibility to use distinct conjugation states (conjugation on-state and conjugation off-state) for information storage and data processing, whereby a carrier system is present that allows the modulation of a multitude of the corresponding [4n]-annulene molecules for the permanent or erasable storage of their corresponding conjugative states.

18. (2X amended) [4n]-heptalenes according to claim 26, whereby said further substituents R are selected from the group comprising substituted or unsubstituted C_1 - C_{12} -alkyl groups or photoactive diazo-containing groups, ~~like azobenzene.~~

27. (amended) Substituted [4n]-annulenes according to claim ~~16~~26, wherein at least one of the groups C^1 , C^2 or R is a group $-\text{COO}-(\text{CH}_2)_n\text{OH}$, a group $-\text{COO}-(\text{CH}_2)_n\text{OOC}-\text{C}(\text{CH}_3)=\text{CH}_2$ or a group $-\text{COO}-(\text{CH}_2)_nC_6H_4-4-\text{CH}=\text{CH}_2$ wherein $n \geq 2$.